



Towards a global comprehensive and transparent framework for cities and local governments enabling an effective contribution to the Paris climate agreement

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The United Nations Framework Convention on Climate Change (UNFCCC) COP 21, including the Paris Agreement, has underlined the role of non-state-actors in limiting temperature increase to 1.5 °C compared to pre-industrial levels. Worldwide, there are an increasing number of transnational networks on climate actions driven by non-state actors. The first attempt to understand the global extent of climate actions taken by non-state actors (such as regional and municipal governments and the corporate sector) was made by a UNFCCC platform launched in 2014 called the Non-State Actor Zone for Climate Actions (NAZCA). However, different reporting frameworks of core data partners contributing to the NAZCA platform represent challenges for tracking and comparing the outcomes of transnational initiatives and their global impact. In this contribution, we focus on the two initiatives most represented in the NAZCA platform: Covenant of Mayors and Compact of Mayors, which were merged into the Global Covenant of Mayors (GCoM) in 2016. We provide a comparative analysis of the reporting frameworks, constituting the starting point of the GCoM merging process. Consequently, we review recent studies investigating their performance and identity in terms of drivers, barriers and mitigation ambition with reference to the particular case of the cities' contribution to the 1.5 °C global warming target. In sum, there is a wealthy literature in investigating the role of the transnational initiatives in supporting cities and promoting the standards for emission accounting, while we are currently lacking a systematic knowledge on their global contribution. The new era of transnational network consolidation entails and reinforces the need for a global, comprehensive and transparent reporting framework for cities and local governments enabling to effectively contribute to the Paris Agreement.

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Current Opinion in Environmental Sustainability 2018, 30:67–74

This review comes from a themed issue on **1.5°C Climate change and urban areas**

Edited by **Karen Seto** and **Diana Ürge-Vorsatz**

For a complete overview see the [Issue](#) and the [Editorial](#)

Available online 3rd April 2018

Received: 16 June 2017; Accepted: 21 March 2018

<https://doi.org/10.1016/j.cosust.2018.03.009>

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Introduction

Urban areas concentrate people and activities that are responsible for high levels of energy consumption, generating about three quarters of global carbon emissions [1]. However, this concentration allows gains in efficiency of infrastructure provision as people use less space per capita for utilities, transportation and residential living [2–4]. Therefore urban areas play a crucial role in mitigating the effects of climate change [5–7]. Worldwide, there is an increasing number of transnational initiatives on climate actions driven by non-state actors. Such international initiatives could accelerate the implementation and increase the effectiveness of national and local policies as they broaden the coalition of willing parties and strengthen the knowledge necessary for implementation [8]. Moreover, they are characterized by a broad membership, setting the foundations for emissions mitigation by proposing practical solutions of the measurement of GHGs. They can help promote the uptake of common standards, and serve as an initial building block towards meaningful climate action, but governments help is needed to shift from coordinating emissions measurement to cooperating on emissions reduction [9,10]. Furthermore, there is a need to link on-the-ground scientific expertise to the needs and requirements of local city decision-makers [11].

In 2014, combined with the Lima-Paris Action Agenda, the NAZCA platform was launched. The platform brings together the commitments to action by companies, cities, subnational regions, investors and civil society organizations to address climate change. More than 11 000 non-State climate commitments made on the road to Paris demonstrate a broad-based support to act on climate change manifesting a growing recognition that climate governance has long ceased to be the exclusive domain of national governments [12^{••}]. Core data partners contributing to the NAZCA platform include (accessed in June 2017): Carbon Disclosure Project, the *carbonn*[®] Climate Registry, the Climate Group, Investors on Climate Change, the UN Global Compact, the Climate Bonds Initiative, Global Covenant of Mayors and the UNEP — DTU Climate Initiatives Platform.

In total, 2508 cities from 118 countries are taking action on climate change on NAZCA, representing 10.2 percent of the global population (757.7 million). The major cities

network contributing to the NAZCA platform are the European Union (EU) based initiative Covenant of Mayors and the US based initiative Compact of Mayors. The two initiatives merged in June 2016 into the new Global Covenant of Mayors for Climate & Energy (GCoM).

The Compact of Mayors network, with 684 cities as of October 2017, representing more than 500 million inhabitants from all over the world, gathers two different reporting platforms: the carbonn[®] Climate Registry and Carbon Disclosure Project. The Covenant of Mayors initiative, launched by the European Commission in 2008, has more than 7600 signatories as of October 2017, covering 238 million inhabitants from European cities, Central Asian and South Mediterranean cities. The peculiarity of Covenant of Mayors, compared to other transnational initiative, is the engagement of small and medium cities (66% of CoM signatories are from local authorities with less than 10 000 inhabitants) in the effort to reduce greenhouse gas emissions.

While there are an increasing number of cities adhering to transnational initiatives, we are currently lacking a systematic assessment of their global impact. NAZCA is a first step in understanding the global extent of climate actions by regional and municipal governments and the corporate sector [13^{••}]. Challenges remain to be addressed for future development on tracking the outcomes of the cities' initiatives [14^{••}].

In this contribution, we focus on local government efforts to mitigate climate change, providing a comparative analysis of two reporting frameworks: Covenant of Mayors and Compact of Mayors. This analysis set the basis of the GCoM merge process on defining a harmonized reporting and monitoring framework for the two initiatives. Consequently, the findings of recent scientific studies are presented, exploiting the Covenant and Compact platforms in terms of: factors influencing the cities' participation in the networks; drivers of the emissions and target settings; tools and strategies for the redaction of the climate action plans; benchmarking the performance of cities, as well as the assessments in terms of global impact.

Towards a global harmonized framework for local climate action planning

Globally, there is a lack of an agreed reporting framework not only for emission accounting [15], but also for the measurement and verification of the urban actions in order to be representative players in climate change. Addressing these issues requires a harmonized, transparent and open reporting framework by cities' initiatives. Various standards have been proposed by city networks/organizations to enable local authorities to produce robust and comparable accounts of their GHG emissions [16].

In this contribution, a comparative analysis of Covenant of Mayors and Compact of Mayors framework is presented. In principle they share a common structure by defining a three step approach for their cities: submission of emission inventories according to their standards; setting mitigation target as well as drawing a climate action plan and lastly, monitoring the progress towards the targets. Built on this cycle, the two initiatives differ mainly on the standards for accounting the emissions in the inventory [15,17–19], on the target setting; on rules for sanctioning non-compliance, and lastly in the data validation and quality check. The comparative analysis constitutes the first step towards a global, harmonized framework for GCoM.

Principles and minimum requirements for emission accounting

The standards for accounting the cities' emissions in the inventory differ mainly in the principles and minimum requirements on the sources, the type of gases and boundary of the inventory to be reported. The Covenant of Mayors recommends using the Baseline Emission Inventory (BEI) standard developed by the Joint Research Centre, as the standard for accounting the GHG emissions at community-scale [20]. According to the principles laid out in the Covenant, the inventory is not meant to be an exhaustive inventory of all emission sources in the territory but focuses on the energy consumption side and on the sectors (buildings and transport) upon which the local authority has a potential influence. The Compact of Mayors recommends using as a standard the Global Protocol for Community-Scale GHG Emissions Inventories (GPC) which was developed by ICLEI, World Resource Institute (WRI) and C40 in 2012. The GPC methodology focuses on geographically defined emissions from both production and consumption activities resulting in more complete data reporting since it suggests the inclusion of all indirect emissions, not only deriving from energy consumption in building and transport sectors, but also from waste, aviation and marine transportation [21].

Regarding the emission sources, the categorization in the BEI of the subsectors is based on the jurisdiction of the different actors (municipal/public and private) and it does not recommend the inclusion of the GHG emissions generated by large industrial power plants (cover by the EU Emissions Trading System). The GPC follows a more coherent approach to the IPCC subdivision into sectors: Stationary Energy, Transport, Waste, Industrial Processes Product Use and Agriculture, Forestry and Other Land Use. Moreover, the GPC foresees the use of notation keys (i.e. providing explanation in case of missing or not occurring/insignificant activities) that adds transparency to the inventories.

About the type of gases, in the BEI only CO₂ reporting is mandatory, nonetheless, CoM signatories can report

emissions of methane (CH₄) and nitrous oxide (N₂O), converted into CO₂-equivalents (CO₂-eq.) according to their global warming potential. They can choose either the standard IPCC approach or the life-cycle assessment (LCA) approach. The GPC standard follows the IPCC approach where all seven GHG emissions gases are included in the inventory.

Lastly, the difference between the two standards is related to the boundary of the emissions inventory. In the GPC standard, the assessment boundary includes all seven GHGs emissions occurring within the geographic boundary of the city, as well as specified emissions occurring out of the boundary as a result of city activities, categorized by scopes. In the BEI, there is no distinction between scopes, where the emissions are divided between direct emission and indirect emissions related to grid supplied energy.

Setting mitigation targets and monitoring the progress

Both frameworks comprehend guidance for setting mitigation targets. In the Compact, the target setting is not bound to the level of nationally determined contribution (NDC) [22]. In contrast, the EU Covenant initiative proposes to its signatories to be more ambitious than the EU NDC, that is, setting a target which is at least or higher than 40% reduction of the GHG emissions by 2030 (before 2016 at least 20% by 2020) in comparison with the 1990 levels, (or the closest subsequent inventory year with reliable data) [20].

A frequent reporting of inventories enables to track the evolution of GHG emissions in local authorities' territory. Covenant signatories, every second year after the submission of the action plan, have to report the status of the implementation of the actions and every fourth year a full emission inventory for evaluation, monitoring and verification purposes, which allows to track progress towards the target set in the action plan. Similarly, in the Compact of Mayors, a complete updated inventory is required every four years from the first submission.

Data handling, validation and quality check

Each Covenant signatory undergoes a validation process of their inventories and action plans, which results in a feedback report for improving the data coherence/completeness [23]. In the compact, the reliability of data is assessed in terms of 'high, medium and low' quality defined by the degree of modelled activity data, ranging from real inventory activity data to highly modelled or uncertain activity data.

Possibilities for sanctioning non-compliance are perhaps the largest difference between national and transnational systems. Sanctioning for non-compliance in the transnational initiatives are related to the diligence in the reporting framework and typically are 'soft' measures, such as

'naming and shaming' or removal of support [24^{••}]. For example, Covenant' signatories that are not compliant with the reporting framework in terms of minimum requirement, timelines and data coherence/completeness are suspended from the initiative [25]. Similarly, in the Compact of Mayors non-compliance in terms of reporting is sanctioned by the suspension of the compliance' badge.

The inclusive approach of the BEI in the Covenant and its relative simplicity in terms of reporting requirements has encouraged small towns and communities as well as larger cities in Europe to engage in the climate agenda. On the other hand, the GPC standard used in the Compact of Mayors initiative has a more comprehensive coverage of emission sources/types, reflecting a more challenging process of data collection.

Global Covenant of Mayors: status of the merging process

As of January 2018, the Global Covenant has more than 7400 city signatories across 6 continents and 121 countries, representing over 680 million people or nearly 10% of the global population divided it in nine areas (Africa; East Asia; Europe; Latin America & the Caribbean; Middle East & West Asia; North America; Oceania; South Asia; Southeast Asia). The GCoM has established four technical working groups (TWGs) in order to develop the harmonized framework covering: Firstly, the regional coherence, secondly, data handling for emission reporting and climate planning, thirdly, financing and finally, communication. The main objective of the data working group is to recommend a harmonized framework for data collection and reporting of emission inventories and climate actions, grounded on the comparative analysis of the existing frameworks. Based on synergies and constructive differences of the two frameworks, and applying principles of transparency, consistency, and flexibility, these recommendations (still under development) are designed to be consistent with national government reporting requirements and the UNFCCC, and adjustable to regional and local circumstances. Afterwards, these set of recommendations will be scrutinized and validated throughout a cities' consultation process, before the final adoption by the end of 2018, to refine the standard and ensure it effectively supports local efforts to take action on climate change.

Literature review of studies exploiting the cities' networks data

Cities that adhere to transnational networks on climate change, although in the absence of obligation, by making publicly available the emission inventories and climate action plan, render themselves accountable both globally as well as locally [26]. Their performance and identity are increasingly scrutinized in terms of global impact and exploited in the scientific literature [27]. In the following, based on literature review of studies, the paper discusses

the findings of scientific studies exploiting the Covenant and Compact initiatives' platforms, in terms of factors influencing the cities' participation in the networks and multilevel governance models observed [14,28,29^{••},30–36]; drivers influencing the emissions and target setting [37–40]; tools and strategies for the redaction of the climate action plans [41–46]; benchmarking methodologies [47,48]; the assessments of the global contribution of cities to the Paris Agreement [49–55] (Kona A, Bertoldi P, Rivas S, Dallemand JF, Monforti-Ferrario F: **Covenant of Mayors signatories leading the way toward 1.5 degree future**. *Sustain Cities Soc* 2018, (Submitted for publication)).

Cities' participation in the networks and multilevel governance models observed

Regarding the factors influencing the cities' participation in the networks, Christoforidis *et al.* [28] examined the barriers preventing the CoM initiative reaching its full potential in Greece. The study observes that significant public acceptance is increased once targets and commitments of the initiative are explained to citizens. Likewise, based on an empirical model that analyzes the decision of Spanish local authorities to join the Covenant of Mayors, Pablo-Romero *et al.* [29^{••}] found that prominent factors that guide the city engagement to the CoM are population density, availability of renewable energy, fiscal and environmental stress, citizens' political preference, the contagion effect of neighboring municipalities, the existence of covenant coordinators, and lastly, economic motivations. Moreover, the authors highlight that municipalities with higher unemployment rates have more probabilities of signing the CoM, seen as a route to encourage the development of energy policies that may contribute to strengthen an industry which generates growth and employment.

By referring to the specific experiences of the province of Foggia [30] and the province of Chieti [31] (intermediary government body in southern Italy), the studies highlight the role of provinces as supporting structures to CoM signatories in preparing and implementing investment programs in the field of the energy efficiency and renewable energy sources. Similarly, Melica *et al.* [32] underlines the role of regions and provinces in the engagement of local authorities with less than 10 000 inhabitants in the CoM initiative and identifies in which EU countries the multilevel governance model observed is likely to be successful.

International networks such as C40 and the Local Governments for Sustainability (ICLEI) have been examined by Rashidi and Path [33] using the Carbon Disclosure Project database of more than 127 cities. The authors find that there are significant differences between the two different networks: cities that are a member of C40 on average adopt more climate policies than those of ICLEI.

The paper concludes by suggesting that cities should decide to choose networks that provide sets of tailor-made policies that meet city requirements.

About the geographical coverage of transnational municipal networks, Bansard *et al.* [14^{••}] found that current membership is skewed towards Europe and North America while countries from the Global South are underrepresented, confirming other results present in literature [34]. The article finds that there is a limited number of networks among the thirteen transnational municipal networks in 2017 that commit to quantified emission reductions. In addition, the monitoring provisions of these networks are fairly limited. For this reason, the study indicates that transnational municipal networks are not (yet) representative, ambitious and transparent players.

Similarly, studies on the geographical coverage in the CoM network, reveal a large variation in climate change response across urban areas in Europe — a variation that is particularly noticeable across city size and north–south direction. Countries like Germany, France, United Kingdom, Sweden and Latvia have a higher share of population in comparison to the share of signatories, suggesting that the participation in the CoM initiative is mainly from large urban areas. On the other hand, countries like Belgium, Spain, and Italy have a higher signatories' share in comparison to the populations' share, suggesting that small urban areas are more active in the CoM initiative than the larger ones [35]. These results on geographical distribution, are in line with the ones extracted from Rivas *et al.* [36] where in the case of more advanced and ambitious communities (usually large and northern cities), the Covenant can be an instrument for achieving intermediate targets. For 'newcomers' to climate and energy planning, especially for small, medium southern European cities, the Covenant is not only a structured way of implementing European and national policies, but also a way of 'rethinking' the city so that it achieves a more sustainable future.

Emissions inventories and target setting

Pablo-Romero *et al.* [37] performed a cross-sectional regression analysis between the planned emissions reductions in the SEAPs and the basic indicators related to the emissions of those cities that have signed the Covenant. Results show that the predicted reductions are greater in cities with higher emissions and energy consumption per capita. Energy consumption per capita is smaller in the large cities, with emissions also tending to be lower, which suggests that urbanization can generate agglomeration benefits that are environmentally effective. The greater production of renewable energy is seen in small municipalities.

Drawing from the original dataset of urban metropolitan carbon footprints (the carbonn[®] Climate Registry), Khan

and Sovacool [38] found that cities with more ambitious commitments do not necessarily have steeper reductions in emissions. Moreover, the study suggests that having long-term self-reported goals do not make the cities perform better in terms of footprint reduction. Nevertheless, the authors point out that the results should be considered in light of the limitations of the database (25 cities from nine countries and five continents) as the data is self-reported with varying levels of quality control. In addition, cities may be using different methodologies to calculate inventories while the small size of the sample and the methods employed in the study are other limitations.

Pablo-Romero *et al.* [39] analyzed municipalities in Andalusia, the region of Spain with more signatories in the CoM, and found that the city engagement to the CoM has a positive influence on the electricity consumption pattern, since there is a steeper reduction of electricity consumption after signing the initiative. Therefore, it may be considered appropriate to promote policies which incentivize the municipalities to join the CoM and develop their action plans, as this can reduce their electricity consumption.

Tools, strategies and benchmarking of the climate action plans

An integrated strategy for surveying, controlling and managing the climate action plan in CoM through a 'Monitoring and Evaluation' process is introduced by Delponte *et al.* in [42]. The authors analyzed the progress of the emissions in the city of Genoa (Italy) in relation to the status of the actions' implementation. They suggested that the difficulties in implementing the Genoa action plan are related to the limited attention paid to 'enhancement factors' of the climate actions plans. These factors include: cost benefit and cost-efficacy analyses of the planned actions, the opportunity of peer reviewing of the climate action plan made by third parties and the expectation of a stronger participatory level.

Leal and Azevedo [43] presented a critical assessment of existing targets set in the context of local energy planning in CoM, in order to understand how they were defined and the implications of different methodological choices. Their paper then discusses an alternative approach for setting a common long-term target that is scientifically based and that reflects the existing global objectives towards climate change mitigation. This target corresponds to reducing the overall global greenhouse gas emissions to the level of 2 tCO₂-eq per capita by the year 2050. The methodology proposed, although based on the overall goal of reaching 2 tCO₂-eq per capita, have to be adjusted to the context of local energy planning by discounting of non-energy related emissions and of those associated with supra-local services like the industry, agriculture and fisheries sectors where the political

competences of local authorities is limited. The methodology applied to nine municipalities in the metropolitan area of Porto (Portugal), shows that the reductions needed by 2025 for all municipalities in order to be aligned with the global target of 2 tCO₂-eq per capita by 2050 vary between 24% and 31% (compared to 2009), ensuring therefore coherence between medium and long-term targets.

Kilkis [47] developed a composite index to benchmark the performance of local energy systems that integrates energy and CO₂ emissions data from CoM platform. The index consists of a unique set of 7 dimensions and 35 main indicators including the environmental, societal, and technological context of local energy systems. The first three dimensions are energy consumption and climate (D1), penetration of energy and CO₂ saving measures (D2), and renewable energy potential and utilization (D3). The last four dimensions are water and environmental quality (D4), CO₂ emissions and industrial profile (D5), city planning and social welfare (D6), and R&D, innovation and sustainability policy (D7)). The values of the indicators are aggregated based on the Min–Max method for a final ranking. The composite index, named SDEWES (Sustainable Development of Energy, Water, and Environment Systems), is applied to a sample of 22 Mediterranean port cities. This is useful for comparative analysis of the magnitude, efficiency, and intensity of energy usage and CO₂ emissions, which trigger learning, action, and collaboration among Mediterranean port cities to increase future performance.

Assessment of the global contribution of cities to Paris Agreement

The IPCC denotes that there is no comprehensive, consistent data sets of urban GHG emissions [49]. In the following, a very fragmented literature investigating the outcomes of the initiatives is presented. To illustrate, the global aggregation of 228 cities' climate commitments reporting under the carbonn[®] Climate Registry and the Carbon Disclosure Project Cities Program, covering 436 million inhabitants, finds that GHG emissions could decrease by 402 Mt CO₂ -eq in 2030, compared with a reference scenario, and by 430 Mt CO₂ -eq in 2050 [50]. The methodology used for assessing the reference scenario is taking into account only the population growth and no other drivers such as technology improvement, economic factors, etc.

Kona *et al.* (Kona A, Bertoldi P, Rivas S, Dallemand JF, Monforti-Ferrario F: **Covenant of Mayors signatories leading the way toward 1.5 degree future**. *Sustain Cities Soc* 2018, (Submitted for publication).) examined CoM signatories' mitigation pathways consistent with limiting the temperature increase to 2°C and 1.5°C above the preindustrial levels. The study proposes two types of scenarios based on the long-term commitments and

monitoring provisions as harmonized approach to estimate 2050 projections of CO₂ reduction at local level. The first scenario, based on the signatories' rates of the emission reductions commitments beyond 2020, shows that CoM signatories are in line with the 2°C global target scenario, which corresponds to reducing the overall global CO₂ emissions to the level of 2tCO₂-eq per capita by 2050. While, the scenario based on the rates of the emission reductions achievements forecasts that CoM signatories could be consistent with the 1.5°C global target scenario, that is, to become net zero by mid-century or shortly after. Aside from the statistical analysis and modelling exercise, a more qualitative analysis on policies has been conducted, highlighting the role of cities and local government's policies in reaching the Paris Agreement targets.

The methodology aforesaid mentioned, used for the CoM assessment (Kona A, Bertoldi P, Rivas S, Dallemand JF, Monforti-Ferrario F: **Covenant of Mayors signatories leading the way toward 1.5 degree future**. *Sustain Cities Soc* 2018, (Submitted for publication).) is completely different from the one used in the Compact of Mayors in [50] previously discussed, as the CoM does not envisage any modelling for a business as usual scenario (reference scenario) of emission from cities by 2030 or 2050. Therefore the outcomes of the two methods are difficult to compare. Moreover, overlapping in terms of city memberships in all these studies is noticed (e.g. Madrid, London, Stockholm, etc.).

Similarly, the assessment of 200 large and medium-scale urban areas across 11 European countries (data retrieved from both networks: Covenant and Compact of Mayors) found that if the planned actions within cities are nationally representative, the 11 countries investigated would achieve a 37% reduction in GHG emissions by 2050, translating into a 27% reduction in GHG emissions for the EU as a whole [51]. The study, a part from the shares, does not provide details on the quantification of the emission in the base years and their intended emission reductions by 2050, as well as on the methodology applied for the assessment of the overall impact.

In absence of comprehensive and harmonized dataset on cities emissions and climate actions, national data have been used for modelling the contribution of cities' actions to the global impact [52]. The analysis conducted for all urban areas considered in the United Nations' World Urbanization Prospects 2011, covering 3.6 billion inhabitants in 2010, finds that urban actions could decrease global GHG emissions by 3.7 Gt CO₂-eq in 2030, compared with a reference scenario, and by 8 Gt CO₂-eq in 2050. The reference scenario of how energy and GHG emissions may evolve in major world regions and economic sectors through 2050 is derived mainly from the IEA Energy Technology Perspectives [53]. Afterwards,

from the reference scenario, a urban action scenario is developed by applying a set of aggressive technologies and practices to curb urban energy use and greenhouse gas emissions derived mainly from the Global Buildings Performance Network [54] and from the Institute for Transportation and Development Policy [55].

Conclusions

Developing a climate action plan that requires establishing an emission inventory, setting ambitious targets and adopting policy measures is an important first step for cities and local governments in mitigating CO₂ emissions. An effective system for tracking progress and producing transparent assessments requires a harmonized and open monitoring and reporting framework for cities and local governments to increase their accountability in the Paris Agreement framework.

As highlighted from the comparative analysis of the Covenant and Compact of Mayors frameworks, the Global Covenant of Mayors resulted from the merge in 2016, will define in the present year (2018) a harmonized framework for the two initiatives.

Cities and local governments, by making publicly available the emission inventories and the climate action plans, are increasingly scrutinized in the scientific literature. Highlights and outcomes are presented from the literature review investigating the platforms in terms of: factors influencing the cities' participation and multilevel governance models observed; drivers influencing the emissions and target setting; tools and strategies for the climate action plans; benchmarking methodologies, as well as the assessments in terms of global impact.

While research has produced valuable insights into causes and consequences of cities' participation in transnational networks, there is a very fragmented literature on assessing the global contribution of cities and local governments to the Paris Agreement. This is due mainly to the absence of global and open dataset on cities' emissions and climate actions, dissimilarities on the methodologies used for emission accounting and reference scenarios, ambitions levels, base years, measurement metrics (per capita or absolute values), as well as overlapping in terms of city memberships. In sum, we are currently lacking systematic knowledge on their global contributions to the Paris Agreement, which thus reinforces the need for a global, comprehensive and transparent framework for cities and local governments.

Future studies shall try to identify which are the best approaches, assuring flexibility to the local context and increasing transparency and comparability. Additional efforts are needed to model the impact of cities in long term pathways. The completeness and the accuracy of the inventories and climate action plans at city scale require

robust and supportive tools. A detailed understanding of all these factors, policies and measures is needed for an effective accountability of cities and local governments to the Paris Agreement.

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